SAR Test Report

FOR:

Manufacturer: Intel Corporation

Model Number: CZ120
Product Description: HSPA+ Smartphone

FCC ID: O2Z-CZ120
IC ID: 1000W-CZ120

Test Report #: SAR_ INTEL_032_13001_FCC

Date of Report: 2013-08-28

FCC Listed #:
A2LA Accredited

IC Recognized #
3462B-1

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1. Assessment

The following device was evaluated against the limits for general population uncontrolled exposure specified in FCC 2.1093 and RSS 102, Issue 4 according to measurement procedures specified in FCC OET Bulletin 65, Supplement C (Edition 01-01), additional FCC regulation as listed in chapter 5, IEEE 1528:2003, IEC 62209-1:2005, and IEC 62209-2:2010 and no deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Intel Corporation	HSPA+ Smartphone	CZ120

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2013-08-28	Compliance	Josie Sabado (Test Lab Manager)	

Responsible for the Report:

Date	Section	Name	Signature
2013-08-28	Compliance	Zack Gray (Project Engineer)	Zack Gray 2013.08.29 19:13:11 -07'00'

The test results of this test report relate exclusively to the test item specified in Section 3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2. Administrative Data

2.1. Identification of the Testing Laboratory Issuing the SAR Test Report

Company Name:	CETECOM Inc.
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Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Test Lab Manager:	Josie Sabado
Responsible Project Leader:	Christina Fuller

2.2. Identification of the Client

Applicant's Name:	Intel Corporation
Street Address:	2200 Mission College MS:SC1-20
City/Zip Code	Santa Clara, CA 94085
Country	USA
Contact Person:	Christine Ryan
Phone No.	4083002167
e-mail:	Christine.m.ryan@intel.com

2.3. Identification of the Manufacturer

Same as above client.

3. Equipment under Test (EUT)

3.1. General Specification of the Equipment under Test

EUT Description:	Smartphone
Model No:	CZ120
Versions:	HW Revisions: PR2.0 and PR3.0 and PR3.1; See additional note regarding HW revisions and information on SW Revisions under sections 3.3 and 4;
FCC ID:	O2Z-CZ120
IC ID:	1000W-CZ120
Product Type:	Portable
RF Exposure Environment:	General / Uncontrolled
Dimensions:	128 x 10 x 67 mm
Exposure Conditions:	Held next to the ear Body worn (no carrying accessory documented) Wireless Router (hotspot mode capability)
Power Back-Off Modes:	None
Antenna Type:	Internal
Operating Voltage Range:	3.6 – 4.2 VDC
Operating Temperature Range:	Tmin: -10°C/ Tmax: 55°C
Prototype/Production:	Identical Prototype
Supported Radios:	GSM/GPRS/EGPRS, MS Class 12, Power Class 4/1, Mobile Class B WCDMA/ HSPA+, Power Class 3, DL cat 24, UL cat 6 (5.7 Mbps uplink and QPSK) Bluetooth v2.1 + EDR 802.11 a/b/g/n, HT20 NFC GPS receiver at 1,575 MHz
Date of Testing:	4/3/2013 - 7/18/2013

3.2. Technical Specification of Supported Radios

Technology	Duty Cycle	Type(s) of Modulation	Band	Transmit Frequency Range (MHz)	Measured Maximum Conducted Output Power (dBm)
GSM	12.5%	GMSK	GSM 850	824.2 – 848.8	32.4
			PCS 1900	1850.2 – 1909.8	30.1
(E)GPRS	1 uplink timeslot:: 12.5% 2 uplink timeslots: 25% 3 uplink timeslots: 37.5% 4 uplink timeslots: 50%	GMSK, 8PSK	GSM 850	824.2 – 848.8	32.3
			PCS 1900	1850.2 – 1909.8	30.3
WCDMA	100%	QPSK, 16 QAM	FDD II	1852.4 – 1907.6	24.5
			FDD IV	1712.4 – 1752.6	17.44
			FDD V	826.4 – 846.6	23.62
Bluetooth	46%	GFSK, π/4 DQPSK, 8DPSK	N/A	2402 – 2480	8.9
802.11 b/g/n	100%	BPSK, QPSK, 16-QAM, 64-QAM	N/A	2412 – 2462	17.68
802.11 a/n	100%	BPSK, QPSK, 16-QAM, 64-QAM	Sub-Band 1	5180 – 5240	13.42
			Sub-Band 2	5260 – 5320	13.55
			Sub-Band 3	5500 – 5700	14.3
			Sub-Band 4	5745 – 5825	14.18
GPS[1]	N/A	N/A	L1	N/A	N/A
NFC[1]	100%	ASK	N/A	13.56	N/A

NOTES:
1. Bands are supported by the EUT, but outside of the scope of this test report.

3.3. Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	HW Version	SW Version
1	RHBEC244302217	PR2.0	RHB JB r42-85
2	RHBEC245300005	PR2.0	RHB JB r42-85
3	RHBEB243400902	PR2.0	RHB JB r42-85
4	RHBEB245400138	PR2.0	RHB JB r42-85
5	RHBEB243200082	PR2.0	RHB JB r42-85
6	RHBEC244302232	PR2.0	RHB JB r42-85
7	RHBEC244302182	PR2.0	RHB JB r42-85
8	RHBMB309100135	PR3.1	RHB JB r42-87

3.4. Identification of Accessory equipment

AE #	Type	Manufacturer
1	Headset	Intel

3.5. Maximum Extrapolated SAR values

Band	Exposure Condition	Measured 1g SAR	Maximum Extrapolated 1g SAR[1]
GSM 850	Head	0.112	0.166
	Body-worn Accessory	0.346	0.489
	Hotspot Mode	0.346	0.489
PCS 1900	Head	0.434	0.590
	Body-worn Accessory	1.42	**1.54**
	Hotspot Mode	1.42	**1.54**
WCDMA FDD II	Head	1.1	**1.30**
	Body-worn Accessory	1.25	1.25
	Hotspot Mode	1.12	1.41
WCDMA FDD IV	Head	0.181	0.198
	Body-worn Accessory	0.494	0.540
	Hotspot Mode	0.698	0.778
WCDMA FDD V	Head	0.091	0.126
	Body-worn Accessory	0.185	0.256
	Hotspot Mode	0.185	0.256
WLAN (DTS)	Head	0.617	0.782
	Body-worn Accessory	0.155	0.195
	Hotspot Mode	0.169	0.212
WLAN (UNII)	Head	0.63	0.856
	Body-worn Accessory	0.173	0.235
	Hotspot Mode	0.344	0.467
Simultaneous Transmission	Head		1.386
	Body-worn Accessory		**1.587**
	Hotspot Mode		1.587

NOTES:
1. Measured 1g SAR extrapolated to manufacturer stated output power upper tolerance limit.

4. Subject of Investigation

The objective of the measurements done by CETECOM Inc. was the dosimetric assessment of the EUT described in section 3. The tests were performed in configurations for devices operated next to a person's body. The examinations were carried out with the dosimetric assessment system DASY52 described in Section 6.

All 3 above identified HW Revisions of the device are subject to approval, PR2.0, PR3.0 and PR3.1.

Since only one out of the documented changes may have an impact on the devices RF exposure relevant behavior (internal cellular antenna matching circuit optimization) full scope SAR testing has been applied to the basic version PR2.0, while only worst case spot checks for the cellular bands were applied to PR3.1.

4.1. The IEEE Standard C95.1 , FCC Exposure Criteria, and IC Exposure Criteria

The FCC limits are set by CFR 47 FCC rule parts 1.1307 and 2.1093. The IC limits are set by RSS 102, Issue 4. The limits are derived from the recommendations in IEEE C95.1-1999 (ANSI/IEEE C95.1-1999), "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz."

4.2. SAR Limit

In this report the comparison between the exposure limits and the SAR data is made using the spatial peak SAR.

Having in mind a worst case consideration, the SAR limit is valid for uncontrolled environment and portable transmitters. The SAR values have to be averaged over a mass of 1g (SAR_{1g}) with the shape of a cube.

Standard	Exposure Condition	Average SAR (W/kg)	Mass Average (g)
OET Bulletin 65C	Partial-Body	1.6	1
RSS 102, Issue 4	Localized Head and Trunk	1.6	1

5. Measurement Procedure

The Federal Communications Commission (FCC) requires routine dosimetric assessment of mobile telecom-communications devices, either by laboratory measurement techniques or by computational modeling, prior to equipment authorization or use. In 2001 the Commission's Office of Engineering and Technology has released Edition 01-01 of Supplement C to OET Bulletin 65. This revised edition, which replaces Edition 97-01, provides additional guidance and information for evaluating compliance of mobile and portable devices with FCC limits for human exposure to radiofrequency emissions. The following KDB publications have additionally been applied:

447498 D01 V05 – General RF Exposure Guidance
648474 D04 V01 – SAR Handsets Multi Xmiter and Ant
865664 D01V01 – SAR measurement 100 MHz to 6 GHz
248227 D01 V01R02 – SAR Measurement Procedures for 802.11 a/b/g Transmitters
941225 D01 V02 – SAR Measurement Procedures for 3G Devices
941225 D02 v02v0 - Guidance for 3GPP R6 and R7 HSPA+
941225 D03 V01 – Recommended SAR Test Reduction Procedures for GSM/GPRS/EDGE

Industry Canada (IC) requirements and measurement techniques regarding RF exposure are described in RSS-102, Issue 4, which refers to the latest version of IEEE 1528 and IEC 62209. IC follows many of the same procedures as applied for compliance with FCC requirements regarding EUT specific technologies and form factors. IC allows the use of the above listed KDBs in most aspects.

5.1. General Requirements

SAR evaluation was performed in a laboratory with an environment which avoids influence on SAR measurements by ambient EM sources and any reflection from the environment itself. The ambient temperature was in the range of 20°C to 26°C and 30-70% humidity. Simulating liquid temperature did not deviate more than +/- 2°C throughout SAR evaluation.

5.2. Body-worn and Other Configurations

Phantom Requirements
For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

Test Position
The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration. Devices with a headset output shall be tested with a connected headset.

Test to be Performed

For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closest spacing to the body. For multiple accessories that contain metallic components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closest spacing to the body must be tested. If the manufacturer provides none body-worn accessories a separation distance of 1.5 cm between the back of the device and the flat phantom is recommended. Other separation distances may be used, but they shall not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

For devices with retractable antenna the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device, or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

5.3. Procedure for assessing the peak spatial-average SAR

Step 1*:* Power reference measurement:

Prior to the SAR test, a local SAR measurement should be taken at a user-selected spatial reference point to monitor power variations during testing.

Step 2: Area scan

The measurement procedures for evaluating SAR associated with wireless handsets typically start with a coarse measurement grid in order to determine the approximate location of the local peak SAR values. This is referred to as the "area scan" procedure. The SAR distribution is scanned along the inside surface of typically half of the head of the phantom but at least larger than the areas projected (normal to the phantom's surface) by the handset and antenna. An example grid is given in Figure 4. The distance between the measured points and phantom surface should be less than 8 mm, and should remain constant (variation less than ± 1 mm) during the entire scan in order to determine the locations of the local peak SAR with sufficient precision. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. The resolution can also be tested using the functions in Annex E (see E.5.2). The approximate locations of the peak SARs should be determined from area scan. Since a given amplitude local peak with steep gradients may produce lower spatial-average SAR than slightly lower amplitude peaks with less steep gradients, it is necessary to evaluate the other peaks as well. However, since the spatial gradients of local SAR peaks are a function of wavelength inside the tissue simulating liquid and incident magnetic field strength, it is not necessary to evaluate peaks that are less than –2dB of the local maximum. Two-dimensional spline algorithms [Press, et al, 1996], [Brishoual, 2001] are typically used to determine the peaks and gradients within the scanned area. If the peak is closer than one-half of the linear dimension of the 1 g or 10 g tissue cube to the

scan border, the measurement area should be enlarged if possible, e.g., by tilting the probe or the phantom (see Figure 5).

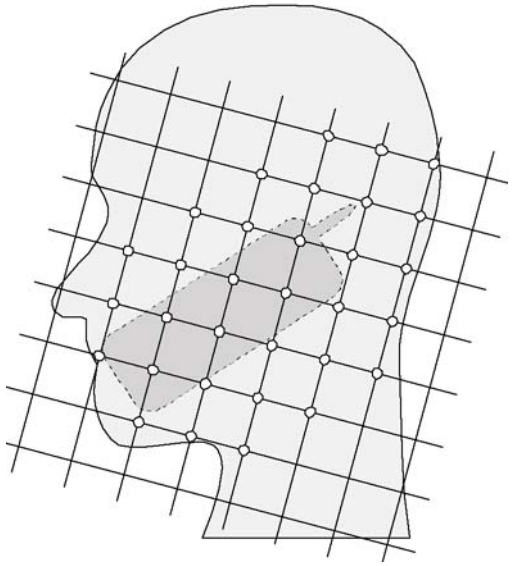


Figure 4 – Example of an area scan including the position of the handset. The scanned area (white dots) should be larger than the area projected by the handset and antenna.

Step 3: Zoom scan

In order to assess the peak spatial SAR values averaged over a 1 g and 10 g cube, fine resolution volume scans, called "zoom scans", are performed at the peak SAR locations determined during the "area scan." The zoom scan volume should have at least 1.5 times the linear dimension of either a 1 g or a 10 g tissue cube for whichever peak spatial-average SAR is being evaluated. The peak local SAR locations that were determined in the area scan (interpolated value) should be on the centerline of the zoom scans. The centerline is the line that is normal to the surface and in the center of the volume scan. If this is not possible, the zoom scan can be shifted but not by more than half the dimension of the 1 g or a 10 g tissue cube.

The maximum spatial-average SAR is determined by a numerical analysis of the SAR values obtained in the volume of the zoom scan, whereby interpolation (between measured points) and extrapolation (between surface and closest measured points) routines should be applied. A 3-D-spline algorithm [Press, et al, 1996], [Kreyszig, 1983], [Brishoual, 2001] can be used for interpolation and a trapezoidal algorithm for the integration (averaging). Scan resolutions of larger than 2 mm can be used provided the uncertainty is evaluated according to E (see E.5).

In some areas of the phantom, such as the jaw and upper head region, the angle of the probe with respect to the line normal to the surface might become large, e.g., at angles larger than ± 30º (see Figure 5), which may increase the boundary effect to an unacceptable level. In these cases, a change in the orientation of the probe and/or the phantom is recommended during the zoom scan so that the angle between the probe housing tube and the line normal to the surface is significantly reduced (<30º).

Step 4: Power reference measurement

The local SAR should be measured at exactly the same location as in Step 1. The absolute value of the measurement drift (the difference between the SAR measured in Step 4 and Step 1) should be recorded in the uncertainty budget. It is recommended that the drift be kept within ± 5%. If this is not possible, even with repeat testing, additional information may be used to demonstrate the power stability during the test. Power reference measurements can be taken after each zoom scan, if more than one zoom scan is needed. However, the drift should always be referred to the initial state with fully charged battery.

5.4. Determination of the largest peak spatial-average SAR

In order to determine the largest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes should be tested for each frequency band according to steps 1 to 3 below.

Step 1: The tests of 6.4 should be conducted at the channel that is closest to the center of the transmit frequency band (*fc*) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom,

b) all configurations for each device position in (a), e.g. antenna extended and retracted, and

c) all operational modes for each device position in (a) and configuration in (b) in each frequency band, e.g. analog and digital.

If more than three frequencies need to be tested, (i.e., Nc > 3), then all frequencies, configurations and modes must be tested for all of the above positions.

Step 2: For the condition providing highest spatial peak SAR determined in Step 1 conduct all tests of 6.4 at all other test frequencies, e.g. lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the spatial peak SAR value determined in Step 1 is within 3dB of the applicable SAR limit, it is recommended that all other test frequencies should be tested as well[1].

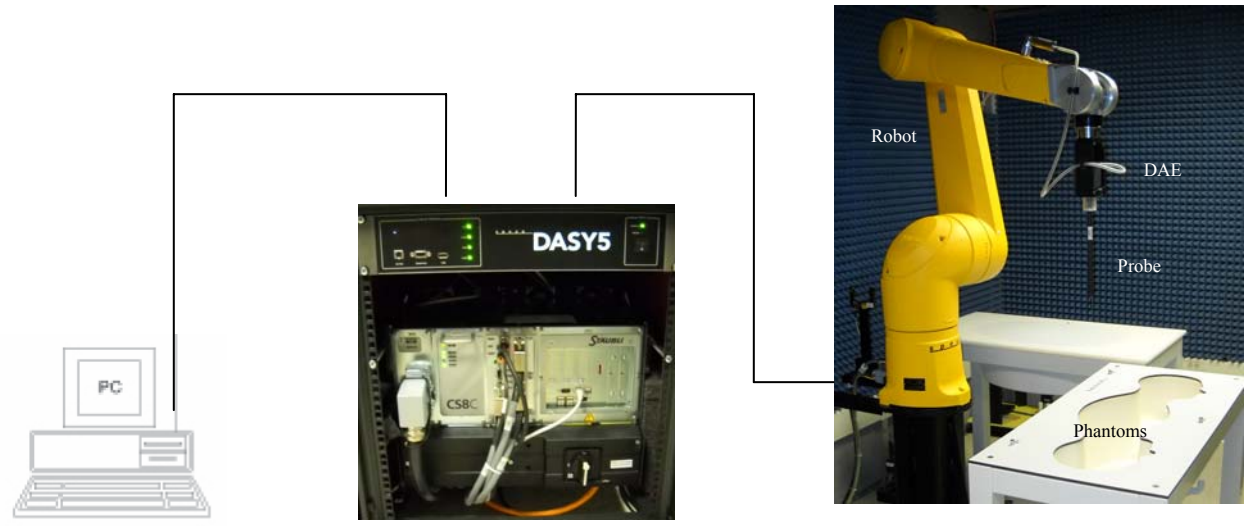
Step 3: Examine all data to determine the largest value of the peak spatial-average SAR found in Steps 1 to 2.

6. The Measurement System

6.1. Robot system specification

The SAR measurement system being used is the SPEAG DASY52 system, which consists of a Stäubli TX90XL 6-axis robot arm and CS8c controller, SPEAG SAR Probe, Data Acquisition Electronics, and SAM Twin Phantom. The robot is used to articulate the probe to programmed positions inside the phantom to obtain the SAR readings from the EUT.

The system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.



Schematic diagram of the SAR measurement system

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centered at that point to determine volume averaged SAR level.

6.2. Isotropic E-Field Probe for Dosimetric Measurements

The probes are constructed using three orthogonal dipole sensors arranged on an interlocking, triangular prism core. The probes have built-in shielding against static charges and are contained within a PEEK cylindrical enclosure material at the tip. Probe calibration is described in the probe's calibration certificate.

6.3. Data Acquisition Electronics

The DAE contains a signal amplifier, multiplexer, 16bit A/D converter and control logic. It uses an optical link for communication with the DASY5 system. The DAE has a dynamic range of -100 to 300 mV. It also contains a two step probe touch detector for mechanical surface detection and emergency robot stop.

6.4. Phantoms

The Twin SAM V4.0 Phantom is designed to specifications defined in IEEE 1528, and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region.

Additionally, the Oval Flat ELI V4.0 Phantom is designed to specification defined in IEEE 1528, and IEC 62209-2. It enables the dosimetric evaluation of body mounted usage.

6.5. Interpolation and Extrapolation schemes

The interpolation, extrapolation and maximum search routines are all based on the modifed Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. The routines construct a once-continuously differentiable function that interpolates the measurement values.

7. Uncertainty Assessment

The uncertainty values for components specified in *FCC Supplement C (01-01) to OET Bulletin 65 (97-01)* were evaluated according to the procedures of *IEEE 1528-2003 December 29, 2002, NIST 1297 1994 edition and ISO Guide to the Expression of Uncertainty in Measurements (GUM).*

7.1. Measurement Uncertainty Budget According to IEEE 1528:2003

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g = c x f / e*	*k*
Uncertainty Component	**Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1-g)**	**1-g u_i (±%)**	**v_i**
Measurement System							
Probe Calibration	E2.1	5.5	N	1	1	5.5	∞
Axial Isotropy	E2.2	4.7	R	√3	0.7	1.9	∞
Hemispherical Isotropy	E2.2	9.6	R	√3	0.7	3.9	∞
Boundary Effect	E2.3	1.0	R	√3	1	0.6	∞
Linearity	E2.4	4.7	R	√3	1	2.7	∞
System Detection Limits	E2.5	1.0	R	√3	1	0.6	∞
Readout Electronics	E2.6	0.3	N	1	1	0.3	∞
Response Time	E2.7	0.8	R	√3	1	0.5	∞
Integration Time	E2.8	2.6	R	√3	1	1.5	∞
RF Ambient Noise	E6.1	3.0	R	√3	1	1.7	∞
RF Ambient Reflections	E6.1	3.0	R	√3	1	1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	0.4	R	√3	1	0.2	∞
Probe Positioning with respect to Phantom Shell	E6.3	2.9	R	√3	1	1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	1.0	R	√3	1	0.6	∞
Test sample Related							
Test Sample Positioning	E4.2	2.9	N	1	1	2.9	*145*
Device Holder Uncertainty	E4.1	3.6	N	1	1	3.6	*5*
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	√3	1	2.9	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	4.0	R	√3	1	2.3	∞
Liquid Conductivity Target - tolerance	E3.2	5.0	R	√3	0.7	1.8	∞
Liquid Conductivity - measurement uncertainty	E3.3	2.5	N	1	0.7	1.6	∞
Liquid Permittivity Target tolerance	E3.2	5.0	R	√3	0.6	1.7	∞
Liquid Permittivity - measurement uncertainty	E3.3	2.5	N	1	0.6	1.5	∞
Combined Standard Uncertainty			RSS			**± 10.7%**	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)			*k*= 2.00705			**± 21.4%**	

A measurement uncertainty assessment has been undertaken following guidance given in IEC-62209-2. Some of the uncertainty contributions are site-specific and, for these, CETECOM, Inc. has assessed the uncertainty contributions arising from local environmental and procedural factors. The resultant uncertainty budget, following the assessment template given IEC-62209-2 is shown below:

7.1. Measurement Uncertainty Budget According to IEC 62209-2

Uncertainty Component	Sec.	Tol. (± %)	Prob. Dist.	Div.	c_i (1-g)	1-g u_i (±%)	v_i
Measurement System							
Probe Calibration	7.2.2.1	6.55	N	1	1	6.55	∞
Axial Isotropy	7.2.2.2	4.7	R	√3	0.7	1.9	∞
Hemispherical Isotropy	7.2.2.2	9.6	R	√3	0.7	3.9	∞
Boundary Effect	7.2.2.6	2.0	R	√3	1	1.2	∞
Linearity	7.2.2.3	4.7	R	√3	1	2.7	∞
Modulation Response	7.2.2.4	2.4	R	√3	1	1.4	∞
System Detection Limits	7.2.2.5	1.0	R	√3	1	0.6	∞
Readout Electronics	7.2.2.7	0.3	N	1	1	0.3	∞
Response Time	7.2.2.8	0.8	R	√3	1	0.5	∞
Integration Time	7.2.2.9	2.6	R	√3	1	1.5	∞
RF Ambient Noise	7.2.4.5	3.0	R	√3	1	1.7	∞
RF Ambient Reflections	7.2.4.5	3.0	R	√3	1	1.7	∞
Probe Positioner Mechanical Tolerance	7.2.3.1	0.8	R	√3	1	0.5	∞
Probe Positioning with respect to Phantom Shell	7.2.3.3	6.7	R	√3	1	3.9	∞
Post Processing	7.2.5	4.0	R	√3	1	2.3	∞
Test sample Related							
Test Sample Positioning	7.2.3.4.3	2.9	N	1	1	2.9	145
Device Holder Uncertainty	7.2.3.4.2	3.6	N	1	1	3.6	5
Power Scaling	L.3	0	R	√3	1	0.0	∞
Output Power Variation - SAR drift measurement	7.2.2.10	5.0	R	√3	1	2.9	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	7.2.3.2	7.9	R	√3	1	4.6	∞
SAR Correction	7.2.4.3	1.9	R	√3	1	1.1	∞
Liquid Conductivity - measurement uncertainty	7.2.4.3	2.5	R	√3	0.78	1.1	∞
Liquid Permittivity - measurement uncertainty	7.2.4.3	2.5	R	√3	0.26	0.3	∞
Temperature Uncertainty – Conductivity	7.2.4.4	3.4	R	√3	0.78	1.5	∞
Temperature Uncertainty – Permittivity	7.2.4.4	0.4	R	√3	0.23	0.1	∞
Combined Standard Uncertainty			RSS			**12.5**	748
Expanded Uncertainty (95% CONFIDENCE INTERVAL)			k= 2.00705			**25.1**	

8. Test results summary

8.1. Conducted Average Output Power

For the cellular bands conducted average output power has been measured and listed below for both HW Revisions, PR 2.0 and PR 3.1 to enable for adequate selection of spot check SAR measurements for revision PR 3.1.

All measured conducted output power values are within the manufacturer's stated tolerances.

Measurement uncertainty for conducted measurements is ±0.5dB

Bluetooth

Average power measured using an average power meter.

Channel	Frequency [MHz]	Average Power [dBm]		
		GFSK	π/4 DQPSK	8-DPSK
0	2402	7.6	5.5	5.5
39	2441	8.7	6.4	6.4
78	2480	8.9	6.5	6.5
Power Tolerance Upper Limit		9.5	9	9

WLAN

Average power measured using an average power meter.

Channel	Frequency [MHz]	Average Power [dBm]		
		802.11b	802.11g	802.11n, HT20
1	2412	17.28	11.18	8.91
6	2437	17.51	11.58	9.18
11	2462	17.68	11.62	9.39
Power Tolerance Upper Limit		18.5	12.5	10.5

WLAN UNII

Average power measured using an average power meter.

Channel	Frequency [MHz]	Average Power [dBm]	
		802.11a, 6 Mbps	802.11n, HT20, 6.5 Mbps
36	**5180**	12.98	12.9
40	**5200**	13.25	13.17
44	**5220**	13.37	13.3
48	**5240**	13.42	13.32
52	**5260**	13.55	13.42
56	**5280**	13.45	13.33
60	**5300**	12.89	12.78
64	**5320**	13.14	13.03
100	**5500**	13.89	13.78
104	**5520**	14.17	14.07
108	**5540**	14.28	14.16
112	**5560**	14.17	14.05
116	**5580**	14	13.87
120	**5600**	14.01	13.88
124	**5620**	14.12	14
128	**5640**	14.29	14.18
132	**5660**	14.27	14.13
136	**5680**	14.2	14.07
140	**5700**	14.3	14.15
149	**5745**	14.18	14.04
153	**5765**	13.83	13.7
157	**5785**	13.73	13.58
161	**5805**	13.9	13.72
165	**5825**	14.17	14.02
Power Tolerance Upper Limit		**15.5**	**15.5**

GSM
Hardware Version PR 2.0

Average power measured using a Rhode and Schwarz CMU 200.

Band	Channel	Frequency [MHz]	Average Power [dBm]	Power Tolerance Upper Limit [dBm]
GSM 850	128	824.2	31.9	33.5
	190	836.6	31.8	
	251	848.8	31.9	
PCS 1900	512	1850.2	29.6	30.5
	661	1880	29.6	
	810	1909.8	29.2	
Hardware Version PR 2.0				
GSM 850	128	824.2	32.4	33.5
	190	836.6	32.3	
	251	848.8	32.2	
PCS 1900	512	1850.2	29.9	30.5
	661	1880	30.1	
	810	1909.8	29.9	
Hardware Version PR 3.1				

GSM 850 Band – (E)GPRS

Average power measured using a Rhode and Schwarz CMU 200.

Number of Uplink Timeslots		Modulation	Channel / Frequency [MHz]						Burst Average Power Tolerance Upper Limit [dBm]
			128 / 824.2		190 / 836.6		251 / 848.8		
			Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	
GPRS	1	GMSK	32	23	31.8	22.8	32	23	**33.5**
	2		32	26	31.8	25.8	32	26	**33.5**
	3		31.2	26.95	31	26.75	31.2	26.95	**32.7**
	4		29.9	26.9	29.7	26.7	29.9	26.9	**31.5**
EGPRS	1	GMSK	32	23	31.8	22.8	32	23	**33.5**
	2		31.9	25.9	31.8	25.8	31.9	25.9	**33.5**
	3		31.1	26.85	31	26.75	31.2	26.95	**32.7**
	4		29.9	26.9	29.7	26.7	29.9	26.9	**31.5**
	1	8PSK	26.1	17.1	26.1	17.1	26.1	17.1	**28**
	2		26.1	20.1	26.1	20.1	26.1	20.1	**28**
	3		25.2	20.95	25.3	21.05	25.3	21.05	**28**
	4		24	21	24	21	24	21	**28**
Hardware Version PR 2.0									
GPRS	1	GMSK	32.3	23.3	32.2	23.2	32.1	23.1	**33.5**
	2		32.4	26.4	32.2	26.2	32.2	26.2	**33.5**
	3		31.5	27.25	31.4	27.15	31.4	27.15	**32.7**
	4		30.3	27.3	30.1	27.1	30.1	27.1	**31.5**
EGPRS	1	GMSK	32.3	23.3	32.2	23.2	32.2	23.2	**33.5**
	2		32.3	26.3	32.2	26.2	32.5	26.5	**33.5**
	3		31.5	27.25	31.4	27.15	31.4	27.15	**32.7**
	4		30.3	27.3	30.1	27.1	30.1	27.1	**31.5**
	1	8PSK	26.6	17.6	26.6	17.6	26.6	17.6	**28**
	2		26.6	20.6	26.6	20.6	26.6	20.6	**28**
	3		25.8	21.55	25.9	21.65	25.9	21.65	**28**
	4		24.5	21.5	24.5	21.5	24.5	21.5	**28**
Hardware Version PR 3.1									

PCS 1900 Band - (E)GPRS

Average power measured using a Rhode and Schwarz CMU 200.

Number of Uplink Timeslots		Modulation	Channel / Frequency [MHz]						Burst Average Power Tolerance Upper Limit [dBm]
			512 / 1850.2		661 / 1880		810 / 1909.8		
			Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	
GPRS	1	GMSK	29.6	20.6	29.6	20.6	29.2	20.2	**30.5**
	2		29.7	23.7	29.7	23.7	29.3	23.3	**30.5**
	3		28.8	24.55	28.8	24.55	28.3	24.05	**29.7**
	4		27.4	24.4	27.5	24.5	27.1	24.1	**28.5**
EGPRS	1	GMSK	29.5	20.5	29.6	20.6	29.1	20.1	**30.5**
	2		29.5	23.5	29.6	23.6	29.1	23.1	**30.5**
	3		28.8	24.55	28.7	24.45	28.7	24.45	**29.7**
	4		27.3	24.3	27.3	24.3	27	24	**28.5**
	1	8PSK	25.9	16.9	25.8	16.8	25.7	16.7	**27**
	2		25.9	19.9	25.8	19.8	25.7	19.7	**27**
	3		25.1	20.85	25	20.75	24.8	20.55	**27**
	4		23.8	20.8	23.7	20.7	23.6	20.6	**27**
Hardware Version PR 2.0									
GPRS	1	GMSK	29.9	20.9	30.3	21.3	30	21	**30.5**
	2		30.1	24.1	30.5	24.5	30.2	24.2	**30.5**
	3		29.35	25.1	29.65	25.4	29.4	25.15	**29.7**
	4		28.1	25.1	28.45	25.45	28.2	25.2	**28.5**
EGPRS	1	GMSK	29.9	20.9	30.3	21.3	30	21	**30.5**
	2		30.1	24.1	30.5	24.5	30.2	24.2	**30.5**
	3		29.35	25.1	29.65	25.4	29.4	25.15	**29.7**
	4		28.1	25.1	28.45	25.45	28.2	25.2	**28.5**
	1	8PSK	26.5	17.5	26.4	17.4	26.4	17.4	**27**
	2		26.5	20.5	26.4	20.4	26.4	20.4	**27**
	3		25.7	21.45	25.7	21.45	25.7	21.45	**27**
	4		24.5	21.5	24.4	21.4	24.4	21.4	**27**
Hardware Version PR 3.1									

WCDMA

Average power measured using a Rhode and Schwarz CMU 200.

Band	Channel	Frequency [MHz]	Average Power [dBm]		Power Tolerance Upper Limit [dBm]
			12.2kbps AMR, 3.4kb SRB	12.2kbps RMC	
FDD II	9262	1852.4	23.5	23.51	24.5
	9400	1880	23.75	23.77	
	9538	1907.6	23.48	23.53	
FDD IV	1312	1712.4	16.41	16.47	17.5
	1413	1732.6	16.72	16.75	
	1513	1752.6	17.01	17.03	
FDD V	4132	826.4	23.06	23.27	24.5
	4175	835	23.05	23.09	
	4233	846.6	23.22	23.23	
Hardware Version PR 2.0					
FDD II	9262	1852.4	24.5	24.5	24.5
	9400	1880	24.35	24.4	
	9538	1907.6	24.5	24.5	
FDD IV	1312	1712.4	17.41	17.44	17.5
	1413	1732.6	17.08	17.11	
	1513	1752.6	17.09	17.1	
FDD V	4132	826.4	23.61	23.62	24.5
	4175	835	23.58	23.58	
	4233	846.6	23.6	23.61	
Hardware Version PR 3.1					

HSDPA

Settings are according to FCC KDB 941225 D01, "SAR Measurement Procedures for 3G Devices" section "Release 5 HSDPA Data Devices"
Average power measured using a Rhode and Schwarz CMU 200. Reference Rhode and Schwarz application note 1CM72: Operation Guide for HSDPA Test Setup according to 3GPP TS 34.121, section 2.2.

Band	Channel	Frequency [MHz]	Average Power [dBm]			
			Sub-test 1	Sub-test 2	Sub-test 3	Sub-test 4
WCDMA FDD II	9262	1852.4	23.13	23.15	23.19	22.95
	9400	1880	23.4	23.47	23.45	23.22
	9538	1907.6	22.75	22.8	22.84	22.59
WCDMA FDD IV	1312	1712.4	16.37	16.36	16.38	16.39
	1413	1732.6	16.69	16.69	16.67	16.68
	1513	1752.6	16.98	17	16.98	17
WCDMA FDD V	4132	826.4	23.27	23.33	23.3	23.09
	4175	835	23.34	23.3	23.35	23.12
	4233	846.6	23.29	23.32	23.3	23.11
Hardware Version PR 2.0						
WCDMA FDD II	9262	1852.4	24.3	24.31	24.35	24.09
	9400	1880	24.11	24.15	24.13	23.91
	9538	1907.6	24.33	24.41	24.37	24.17
WCDMA FDD IV	1312	1712.4	17.35	17.37	17.39	17.33
	1413	1732.6	16.96	16.97	17.02	16.97
	1513	1752.6	17.06	17.06	17.05	17.06
WCDMA FDD V	4132	826.4	23.74	23.71	23.71	23.49
	4175	835	23.61	23.6	23.63	23.43
	4233	846.6	23.68	23.69	23.71	23.44
Hardware Version PR 3.1						

HSUPA

Settings are according to FCC KDB 941225 D01, "SAR Measurement Procedures for 3G Devices" section "Release 6 HSPA Data Devices"

Average power measured using a Rhode and Schwarz CMU 200. Reference Rhode and Schwarz application note 1CM73: Operation Guide for HSUPA Test Setup according to 3GPP TS 34.121, section 2.1 and 2.2.

Band	Channel	Frequency [MHz]	Average Power [dBm]				
			Sub-test 1	Sub-test 2	Sub-test 3	Sub-test 4	Sub-test 5
WCDMA FDD II	9262	1852.4	22.62	20.64	21.67	20.81	22.61
	9400	1880	22.96	20.91	22.05	21.03	22.93
	9538	1907.6	22.23	20.39	21.3	20.47	22.19
WCDMA FDD IV	1312	1712.4	15.64	15.97	15.78	15.46	15.18
	1413	1732.6	16.03	16.36	15.76	15.83	15.43
	1513	1752.6	16.32	16.61	16.47	15.96	15.72
WCDMA FDD V	4132	826.4	22.69	20.69	21.65	20.75	22.58
	4175	835	22.66	20.65	21.72	20.78	22.61
	4233	846.6	22.59	20.52	21.62	20.81	22.55
Hardware Version PR 2.0							
WCDMA FDD II	9262	1852.4	23.7	21.67	22.79	21.94	23.7
	9400	1880	23.5	21.35	22.58	21.59	23.5
	9538	1907.6	23.64	21.67	22.74	21.97	23.67
WCDMA FDD IV	1312	1712.4	16.04	16.82	16.77	16.16	16.14
	1413	1732.6	15.62	16.55	16.43	15.81	15.84
	1513	1752.6	15.63	16.57	16.54	15.97	15.93
WCDMA FDD V	4132	826.4	22.82	21.01	22.01	21.17	22.94
	4175	835	22.75	20.83	21.95	21.1	22.91
	4233	846.6	22.82	20.94	21.94	21.22	22.98
Hardware Version PR 3.1							

8.2. Stand-Alone SAR Evaluation Exclusion

The below rules were exercised for stand-alone SAR evaluation exclusion for the EUT described in section 3.

Antenna	Operation Mode	SAR Evaluation Exclusion Reason
WLAN	802.11g 802.11n	According to KDB 248227, 802.11g and/or 802.11n HT20 is not required when the maximum average output power is < ¼ dB higher than that measured on the corresponding 802.11b channels.
Bluetooth	GFSK π/4 DQPSK 8DPSK	According to KDB 447498, Bluetooth is not required when [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] · [$\sqrt{f_{(GHz)}}$] ≤ 3.0. The highest power for Bluetooth is 9.5 dBm (9 mW) The test separation distance is 5 mm. The worst case frequency for Bluetooth is 2.480 GHz. (9 mW) / (5 mm) · √(2.480 GHz) = 2.8
Cellular	GSM 850 band, 8PSK Modulation	According to KDB 941225 and IEEE 1528-2003 footnote 11, SAR evaluation for low-power modes (8PSK Modulation) are required for devices that produced a peak SAR larger than one half of the compliance limit. The highest SAR value for GMSK is less than one half of the 1.6 W/kg limit. SAR evaluation for 8PSK modulation is not required.
Cellular	HSDPA, HSUPA	According to KDB 941225, SAR evaluation is not required when the maximum average output power is < ¼ dB higher than that measured on the corresponding channels without HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is less than 1.2 W/kg.

8.3. Test Positions and Configurations

Exposure Condition	Distance	Position	Positioning Photo (Appendix B)
Head SAR	0 mm	Left Touch	Photo 1
		Left 15° Tilt	Photo 2
		Right Touch	Photo 3
		Right 15° Tilt	Photo 4
Body-worn / Hot Spot Mode SAR	10 mm	Front	Photo 5
		Back	Photo 6
		Bottom Edge	Photo 7
		Left Edge	Photo 8
		Right Edge	Photo 9
		Top Edge	Photo 10

KDB 941225 D06 states the positions to be tested for personal wireless router mode is any face or edge within 2.5 cm of the antenna. See antenna locations in Appendix B for antenna locations. The following positions / antenna combinations are excluded for the given distance:

- Top edge / cellular – 111 mm
- Bottom edge / WLAN - 122 mm
- Left edge / WLAN – 41 mm

Hot Spot Mode Positions			
Antenna	**Face / Edge**	**Antenna-Edge Distance (mm)**	**Tested**
Cellular	Front	5	Yes
	Back	0	Yes
	Bottom Edge	1.6	Yes
	Top Edge	111	No
	Left Edge	2	Yes
	Right Edge	2	Yes
WLAN / Bluetooth	Front	6	Yes
	Back	0	Yes
	Bottom Edge	122	No
	Top Edge	2	Yes
	Left Edge	41	No
	Right Edge	10	Yes

WLAN is tested with 100% duty cycle. According to SPEAG user manual section 27.2, CW can be assumed which results in crest factor 1.

High and low channels of a band are evaluated for the worst case positions for all exposure conditions for at least one band regardless of the SAR value on the middle channel, according to guidance in Industry Canada Notice 2012-DRS1203. FCC only requires that high and low channels be evaluated when the SAR value on the middle channel is more than 3 dB below the limit.

For GSM bands, the uplink timeslot configuration with the highest source-based time-averaged output power is used for full SAR evaluation for body exposure positions. Spot check measurements for other uplink timeslot configurations are performed on the position with the highest measured SAR value to ensure compliance.

For reasons explained in section 4, full scope SAR testing has been applied to the basic revision PR2.0 of the device only, while only worst case spot checks for the cellular bands were applied to PR3.1.

8.4. SAR Results for Head

GSM 850

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
GSM	190	836.6	Right Touch	0.102	31.8	33.5	0.151	Plot 1
			Right 15° Tilt	0.072	31.8	33.5	0.106	Plot 2
			Left Touch	0.112	31.8	33.5	0.166	Plot 3
			Left 15° Tilt	0.089	31.8	33.5	0.132	Plot 4
Spot check with HW Version PR3.1								
GSM	190	836.6	Left Touch	0.087	32.3	33.5	0.114	Plot 5

GSM 1900

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
GSM	661	1880	Right Touch	0.184	29.6	30.5	0.226	Plot 6
			Right 15° Tilt	0.166	29.6	30.5	0.204	Plot 7
			Left Touch	0.434	29.6	30.5	0.534	Plot 8
			Left 15° Tilt	0.159	29.6	30.5	0.196	Plot 9
Spot check with HW Version PR3.1								
GSM	661	1880	Left Touch	0.538	30.1	30.5	0.590	Plot 10

WCDMA FDD II

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
12.2 kbps RMC	9400	1880	Right Touch	0.61	23.77	24.5	0.722	Plot 11
			Right 15° Tilt	0.379	23.77	24.5	0.448	Plot 12
			Left Touch	1.11	23.77	24.5	1.30	Plot 13
			Left 15° Tilt	0.432	23.77	24.5	0.511	Plot 14
	9262	1852.4	Left Touch	1.01	23.51	24.5	1.27	Plot 15
	9538	1907.6	Left Touch	0.883	23.53	24.5	1.10	Plot 16
Spot check with HW Version PR3.1								
12.2 kbps RMC	9400	1880	Left Touch	1.17	24.4	24.5	1.197	Plot 17
	9262	1852.4	Left Touch	1.23	24.5	24.5	1.23	Plot 18
	9538	1907.6	Left Touch	1.09	24.5	24.5	1.09	Plot 19

WCDMA FDD IV

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
12.2 kbps RMC	1413	1732.6	Right Touch	0.0795	16.75	17.5	0.094	Plot 20
			Right 15° Tilt	0.035	16.75	17.5	0.042	Plot 21
			Left Touch	0.031	16.75	17.5	0.038	Plot 22
			Left 15° Tilt	0.033	16.75	17.5	0.039	Plot 23
Spot check with HW Version PR3.1								
12.2 kbps RMC	1413	1732.6	Right Touch	0.181	17.08	17.5	0.198	Plot 24

WCDMA FDD V

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
12.2 kbps RMC	4183	836.6	Right Touch	0.073	23.09	24.5	0.101	Plot 25
			Right 15° Tilt	0.072	23.09	24.5	0.099	Plot 26
			Left Touch	0.091	23.09	24.5	0.126	Plot 27
			Left 15° Tilt	0.072	23.09	24.5	0.1	Plot 28
Spot check with HW Version PR3.1								
12.2 kbps RMC	4183	836.6	Left Touch	0.102	23.58	24.5	0.126	Plot 29

WLAN 802.11b

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
DSSS with CCK, 1 Mbit/s	6	2437	Right Touch	0.363	17.51	18.5	0.456	Plot 30
			Right 15° Tilt	0.355	17.51	18.5	0.446	Plot 31
			Left Touch	0.617	17.51	18.5	0.782	Plot 32
			Left 15° Tilt	0.545	17.51	18.5	0.684	Plot 33

WLAN 802.11a

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
BPSK, 6 Mbit/s	36	5180	Right Touch	0.166	12.98	15.5	0.297	Plot 34
			Right 15° Tilt	0.196	12.98	15.5	0.350	Plot 35
			Left Touch	0.199	12.98	15.5	0.356	Plot 36
			Left 15° Tilt	0.241	12.98	15.5	0.431	Plot 37
	48	5240	Left 15° Tilt	0.328	13.42	15.5	0.530	Plot 38
	52	5260	Right Touch	0.189	13.55	15.5	0.296	Plot 39
			Right 15° Tilt	0.239	13.55	15.5	0.374	Plot 40
			Left Touch	0.202	13.55	15.5	0.316	Plot 41
			Left 15° Tilt	0.182	13.55	15.5	0.285	Plot 42
	60	5300	Right 15° Tilt	0.219	12.89	15.5	0.399	Plot 43
	104	5520	Right Touch	0.405	14.17	15.5	0.550	Plot 44
			Right 15° Tilt	0.630	14.17	15.5	0.856	Plot 45
			Left Touch	0.599	14.17	15.5	0.814	Plot 46
			Left 15° Tilt	0.565	14.17	15.5	0.767	Plot 47
	116	5580	Right 15° Tilt	0.433	14	15.5	0.612	Plot 48
	140	5700	Right 15° Tilt	0.243	14.3	15.5	0.320	Plot 49
	149	5745	Right Touch	0.171	14.18	15.5	0.232	Plot 50
			Right 15° Tilt	0.225	14.18	15.5	0.305	Plot 51
			Left Touch	0.206	14.18	15.5	0.279	Plot 52
			Left 15° Tilt	0.268	14.18	15.5	0.363	Plot 53
	161	5805	Left 15° Tilt	0.227	13.9	15.5	0.328	Plot 54

8.5. SAR Results for Wireless Router Mode

GSM 850

Operation Mode is in GPRS using GMSK modulation unless otherwise indicated.

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
3 Uplink Timeslots	190	836.6	Front 10mm	0.276	31	32.7	0.408	Plot 55
			Back 10mm	0.282	31	32.7	0.417	Plot 56
			Bottom Edge 10mm	0.022	31	32.7	0.032	Plot 57
			Left Edge 10mm	0.255	31	32.7	0.377	Plot 58
			Right Edge 10mm	0.266	31	32.7	0.393	Plot 59
	128	824.2	Back 10mm	0.285	31.2	32.7	0.403	Plot 60
	251	848.8	Back 10mm	0.293	31.2	32.7	0.414	Plot 61
4 Uplink Timeslots	251	848.8	Back 10mm	0.346	29.7	31.5	0.489	Plot 62
2 Uplink Timeslots	251	848.8	Back 10mm	0.277	31.8	33.5	0.41	Plot 63
1 Uplink Timeslots	251	848.8	Back 10mm	0.137	31.8	33.5	0.203	Plot 64
Spot check with HW Version PR3.1								
4 Uplink Timeslots	251	848.8	Back 10mm	0.292	30.1	33.5	0.394	Plot 65

GSM 1900

Operation Mode is in GPRS using GMSK modulation unless otherwise indicated.

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
3 Uplink Timeslots	661	1880	Front 10mm	0.811	28.8	29.7	0.998	Plot 66
			Back 10mm	0.693	28.8	29.7	0.853	Plot 67
			Bottom Edge 10mm	0.798	28.8	29.7	0.982	Plot 68
			Left Edge 10mm	0.526	28.8	29.7	0.647	Plot 69
			Right Edge 10mm	0.159	28.8	29.7	0.196	Plot 70
	512	1850.2	Front 10mm	1.18	28.8	29.7	1.45	Plot 71
	810	1909.8	Front 10mm	0.737	28.3	29.7	1.02	Plot 72
4 Uplink Timeslots	512	1850.2	Front 10mm	1.18	27.5	28.5	1.49	Plot 73
2 Uplink Timeslots	512	1850.2	Front 10mm	0.959	29.7	30.5	1.15	Plot 74
1 Uplink Timeslots	512	1850.2	Front 10mm	0.468	29.6	30.5	0.576	Plot 75
REPEATABILITY MEASUREMENT								
3 Uplink Timeslots	512	1850.2	Front 10mm	1.14	28.8	29.7	1.40	Plot 76
Spot check with HW Version PR3.1								
3 Uplink Timeslots	661	1880	Front 10mm	1.12	29.65	29.7	1.13	Plot 77
	512	1850.2	Front 10mm	1.42	29.35	29.7	1.54	Plot 78
	810	1909.8	Front 10mm	1.07	29.4	29.7	1.15	Plot 79

FDD II

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
12.2 kbps RMC	9400	1880	Front 10mm	0.824	23.77	24.5	0.975	Plot 82
			Back 10mm	0.799	23.77	24.5	0.945	Plot 83
			Bottom Edge 10mm	0.883	23.77	24.5	1.05	Plot 84
			Left Edge 10mm	0.499	23.77	24.5	0.59	Plot 85
			Right Edge 10mm	0.159	23.77	24.5	0.188	Plot 86
	9262	1852.4	Bottom Edge 10mm	1.12	23.51	24.5	1.41	Plot 87
	9538	1907.6	Bottom Edge 10mm	0.529	23.53	24.5	0.661	Plot 88
	REPEATABILITY MEASUREMENT							
	9262	1852.4	Bottom Edge 10mm	1.05	23.51	24.5	1.32	Plot 89
Spot check with HW Version PR3.1								
12.2 kbps RMC	9400	1880	Bottom Edge 10mm	0.844	24.4	24.5	0.864	Plot 90
	9262	1852.4	Bottom Edge 10mm	1.33	24.5	24.5	1.33	Plot 91
	9538	1907.6	Bottom Edge 10mm	0.594	24.5	24.5	0.594	Plot 92

FDD IV

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
12.2 kbps RMC	1413	1732.6	Front 10mm	0.355	16.75	17.5	0.422	Plot 97
			Back 10mm	0.196	16.75	17.5	0.233	Plot 98
			Bottom Edge 10mm	0.492	16.75	17.5	0.585	Plot 99
			Left Edge 10mm	0.057	16.75	17.5	0.068	Plot 100
			Right Edge 10mm	0.054	16.75	17.5	0.065	Plot 101
	1312	1712.4	Bottom Edge 10mm	0.289	16.47	17.5	0.366	Plot 102
	1513	1752.6	Bottom Edge 10mm	0.698	17.03	17.5	0.778	Plot 103
Spot check with HW Version PR3.1								
12.2 kbps RMC	1413	1732.6	Bottom Edge 10mm	0.655	17.11	17.5	0.717	Plot 104

FDD V

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
12.2 kbps RMC	4183	836.6	Front 10mm	0.135	23.09	24.5	0.187	Plot 106
			Back 10mm	0.185	23.09	24.5	0.256	Plot 107
			Bottom Edge 10mm	0.011	23.09	24.5	0.015	Plot 108
			Left Edge 10mm	0.124	23.09	24.5	0.172	Plot 109
			Right Edge 10mm	0.138	23.09	24.5	0.191	Plot 110
Spot check with HW Version PR3.1								
12.2 kbps RMC	4183	836.6	Back 10mm	0.128	23.58	24.5	0.158	Plot 111

WLAN 802.11b

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
DSSS with CCK, 1 Mbit/s	6	2437	Front 10mm	0.115	17.51	18.5	0.144	Plot 112
			Back 10mm	0.155	17.51	18.5	0.195	Plot 113
			Top Edge 10mm	0.169	17.51	18.5	0.212	Plot 114
			Right Edge 10mm	0.1	17.51	18.5	0.126	Plot 115

WLAN 802.11a

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
BPSK, 6 Mbit/s	36	5180	Front 10mm	0.033	12.98	15.5	0.059	Plot 116
			Back 10mm	0.048	12.98	15.5	0.086	Plot 117
			Top 10mm	0.07	12.98	15.5	0.125	Plot 118
			Right Edge 10mm	0.012	12.98	15.5	0.021	Plot 119
	48	5240	Top 10mm	0.094	13.42	15.5	0.153	Plot 120
	52	5260	Front 10mm	0.082	13.55	15.5	0.129	Plot 121
			Back 10mm	0.074	13.55	15.5	0.115	Plot 122
			Top 10mm	0.169	13.55	15.5	0.265	Plot 123
			Right Edge 10mm	0.013	13.55	15.5	0.021	Plot 124
	60	5300	Top 10mm	0.154	12.89	15.5	0.281	Plot 125
	104	5520	Front 10mm	0.171	14.17	15.5	0.232	Plot 126
			Back 10mm	0.173	14.17	15.5	0.235	Plot 127
			Top 10mm	0.344	14.17	15.5	0.467	Plot 128
			Right Edge 10mm	0.056	14.17	15.5	0.076	Plot 129
	116	5580	Top 10mm	0.235	14	15.5	0.332	Plot 130
	140	5700	Top 10mm	0.106	14.3	15.5	0.14	Plot 131
	149	5745	Front 10mm	0.049	14.18	15.5	0.066	Plot 132
			Back 10mm	0.061	14.18	15.5	0.082	Plot 133
			Top 10mm	0.085	14.18	15.5	0.115	Plot 134
			Right Edge 10mm	0.027	14.18	15.5	0.036	Plot 135
	161	5805	Top 10mm	0.074	13.9	15.5	0.107	Plot 136

8.6. SAR Results for Body-worn accessory

*The majority of results in the section contain duplicate data from the hot-spot mode SAR results section since the back and front of the device were to be tested at the same 10mm distance for each exposure condition. The data is repeated here to separate the results by exposure condition.

GSM 850

Operation Mode is in GPRS using GMSK modulation unless otherwise indicated.

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
3 Uplink Timeslots	190	836.6	Front 10mm	0.276	31	32.7	0.408	Plot 55
			Back 10mm	0.282	31	32.7	0.417	Plot 56
	128	824.2	Back 10mm	0.285	31.2	32.7	0.403	Plot 60
	251	848.8	Back 10mm	0.293	31.2	32.7	0.414	Plot 61
4 Uplink Timeslots	251	848.8	Back 10mm	0.346	29.7	31.5	0.489	Plot 62
2 Uplink Timeslots	251	848.8	Back 10mm	0.277	31.8	33.5	0.41	Plot 63
1 Uplink Timeslots	251	848.8	Back 10mm	0.137	31.8	33.5	0.203	Plot 64
Spot check with HW Version PR3.1								
4 Uplink Timeslots	251	848.8	Back 10mm	0.292	30.1	33.5	0.394	Plot 65

GSM 1900

Operation Mode is in GPRS using GMSK modulation unless otherwise indicated.

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
3 Uplink Timeslots	661	1880	Front 10mm	0.811	28.8	29.7	0.998	Plot 66
			Back 10mm	0.693	28.8	29.7	0.853	Plot 67
	512	1850.2	Front 10mm	1.18	28.8	29.7	1.45	Plot 71
	810	1909.8	Front 10mm	0.813	28.3	29.7	1.02	Plot 72
4 Uplink Timeslots	512	1850.2	Front 10mm	1.18	27.7	28.5	1.49	Plot 73
2 Uplink Timeslots	512	1850.2	Front 10mm	0.959	29.8	30.5	1.15	Plot 74
1 Uplink Timeslots	512	1850.2	Front 10mm	0.468	29.7	30.5	0.576	Plot 75
3 Uplink Timeslots	512	1850.2	Front 10mm with Headset	1.11	28.8	29.7	1.37	Plot 80
3 Uplink Timeslots / 8PSK	512	1850.2	Front 10mm	0.349	25.7	27	0.541	Plot 81
REPEATABILITY MEASUREMENT								
3 Uplink Timeslots	512	1850.2	Front 10mm	1.14	28.8	29.7	1.40	Plot 76
Spot check with HW Version PR3.1								
3 Uplink Timeslots	661	1880	Front 10mm	1.12	29.65	29.7	1.13	Plot 77
	512	1850.2	Front 10mm	1.42	29.4	29.7	1.54	Plot 78
	810	1909.8	Front 10mm	1.07	29.35	29.7	1.15	Plot 79

FDD II

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
12.2 kbps RMC	9400	1880	Front 10mm	0.824	23.77	24.5	0.975	Plot 82
			Back 10mm	0.799	23.77	24.5	0.945	Plot 83
	9262	1852.4	Front 10mm	0.965	23.51	24.5	1.21	Plot 93
			Front 10mm with headset	0.944	23.51	24.5	1.19	Plot 94
	9538	1907.6	Front 10mm	0.674	23.53	24.5	0.843	Plot 95
Spot check with HW Version PR3.1								
12.2 kbps RMC	9262	1852.4	Front 10mm	1.25	24.5	24.5	1.25	Plot 96

FDD IV

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
12.2 kbps RMC	1413	1732.6	Front 10mm	0.355	16.75	17.5	0.422	Plot 97
			Back 10mm	0.196	16.75	17.5	0.233	Plot 98
Spot check with HW Version PR3.1								
12.2 kbps RMC	1413	1732.6	Front 10mm	0.494	17.11	17.5	0.54	Plot 105

FDD V

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
12.2 kbps RMC	4183	836.6	Front 10mm	0.135	23.09	24.5	0.187	Plot 106
			Back 10mm	0.185	23.09	24.5	0.256	Plot 107
Spot check with HW Version PR3.1								
12.2 kbps RMC	4183	836.6	Back 10mm	0.128	23.58	24.5	0.158	Plot 111

WLAN 802.11b

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
DSSS with CCK, 1 Mbit/s	6	2437	Front 10mm	0.115	17.51	18.5	0.144	Plot 112
			Back 10mm	0.155	17.51	18.5	0.195	Plot 113

WLAN 802.11a

Operation Mode	Channel	Frequency (MHz)	Position	SAR 1g (W/kg)	Measured Burst Average Power [dBm]	Upper Tolerance [dBm]	Extrapolated SAR 1g (W/kg)	Results (Appendix A)
BPSK, 6 Mbit/s	36	5180	Front 10mm	0.033	12.98	15.5	0.059	Plot 116
			Back 10mm	0.048	12.98	15.5	0.086	Plot 117
	52	5260	Front 10mm	0.082	13.55	15.5	0.129	Plot 121
			Back 10mm	0.074	13.55	15.5	0.115	Plot 122
	104	5520	Front 10mm	0.171	14.17	15.5	0.232	Plot 126
			Back 10mm	0.173	14.17	15.5	0.235	Plot 127
	149	5745	Front 10mm	0.049	14.18	15.5	0.066	Plot 132
			Back 10mm	0.061	14.18	15.5	0.082	Plot 133

8.7. Simultaneous Transmission SAR Evaluation Consideration

According to KDB 648474, SAR evaluation for simultaneous transmission can be excluded when specific requirements are satisfied.

Positions used in simultaneous transmission analysis are the positions with the highest SAR value in the band.

Estimated SAR for Bluetooth
The equation used to estimate SAR is
(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f(GHz)/x] W/kg where x = 7.5 for 1-g SAR

Power (mW)	Exposure Condition	Test Separation Distance (mm)	Frequency (GHz)	Estimated SAR (W/kg)
8.91	Head	5	2.45	0.378
	Body-Worn Accessory / Wireless Router	10	2.45	0.189

Summary of Critical Maximum Stand Alone SAR Values for Analysis

Exposure Condition	Position	Antenna	Highest Extrapolated SAR 1g (W/kg)	Coordinate Locations[1] (mm)	
				x	y
Head	Left Touch	WCDMA FDD II	1.30	57.6	246
		802.11b	0.782	15	318
		802.11a	0.856	3.83	322
		Bluetooth[2,3]	0.378	35.1	354.25
Body Worn Accessory / Wireless Router SAR	Front 10mm	PCS 1900	1.54	-25.5	-65.5
		WCDMA FDD II	1.41	-11.5	-60
		802.11b	0.144	5.5	59
		802.11a	0.232	22.5	68.5
		Bluetooth[2,3]	0.189	16.5	58

NOTE:
1. Origin of coordinate locations for body worn accessory and wireless router SAR is center of EUT
2. SAR value is calculated.
3. Bluetooth coordinates at Bluetooth antenna feed point.

Exposure Condition	Position	Simultaneous Transmission Combinations	Sum of SAR 1g (W/kg)	Peak location separation distance (mm)	SAR to Peak Location Separation Ratio[1,2]
Head SAR	Left Touch	WCDMA + 802.11b	2.08	83.66	0.036
		WCMDA + 802.11a	2.16	93.1	0.034
		WCDMA + Bluetooth	1.68	110.56	0.020
Body Worn Accessory / Wireless Router SAR	Front 10 mm	PCS 1900 + 802.11b	1.68	128.3	0.013
		PCS1900 + 802.11a	1.72	142.3	0.016
		PCS1900 + Bluetooth	1.73	130.45	0.017
		WCDMA + 802.11b	1.55		
		WCDMA + 802.11a	1.64	132.9	0.016
		WCDMA + Bluetooth	1.60	121.28	0.017

NOTE:
1. SAR to Peak Location Separation Ratio is only calculated if the Sum of SAR 1g (W/kg) is equal to or greater than 1.6 W/kg.
2. SAR to Peak Location Separation Ratio is calculated as $(SAR_1 + SAR_2)^{1.5}/R_i$, where R_i is the separation distance between the peak SAR locations.

Exposure Condition	Simultaneous Transmission Antenna Combinations	Simultaneous Transmission SAR Evaluation Exclusion Reason
Head SAR	WLAN and Cellular	SAR to Peak Location Separation Ratio is ≤ 0.04
	Bluetooth and Cellular	Sum of SAR 1g is less than 1.6 W/kg
Body Worn Accessory / Wireless Router SAR	WLAN and Cellular	SAR to Peak Location Separation Ratio is ≤ 0.04
	Bluetooth and Cellular	Sum of SAR 1g is less than 1.6 W/kg

8.8. Dipole verification

Prior to formal testing at each frequency a system verification was performed in accordance with IEEE 1528. The 1 Watt reference SAR value is taken from the SPEAG dipole calibration report as required by FCC KDB 450824 D01. All of the testing described in this report was performed within 24 hours of the system verification. The following results were obtained:

Date	Liquid Type	Frequency (MHz)	CW input at dipole feed (Watts)	1g SAR (W/kg)[1]	1 Watt reference SAR value (W/kg)	Difference reference SAR value to normalized SAR	Results (Appendix A)
4/10/2013	HSL	835	1	9.12	9.47	-3.7%	Plot 137
4/18/2013	HSL	835	1	10.1	9.47	6.65%	Plot 138
4/19/2013	HSL	835	1	9.47	9.47	0%	Plot 139
7/11/2013	HSL	835	1	9.79	9.47	3.38%	Plot 140
5/13/2013	HSL	1750	1	33.6	35.9	-6.41%	Plot 141
7/19/2013	HSL	1750	1	33.4	35.9	-7%	Plot 142
4/8/2013	HSL	1900	1	38.7	39.1	-1.02%	Plot 143
7/17/2013	HSL	1900	1	39.3	39.1	0.51%	Plot 144
4/18/2013	HSL	2450	1	50.1	52.8	-5.11%	Plot 145
5/7/2013	HSL	5200	0.1	74	80.3	-7.85%	Plot 146
5/8/2013	HSL	5800	0.1	77.7	78.9	-1.52%	Plot 147
5/10/2013	HSL	5200	0.1	75.2	80.3	-6.35%	Plot 148
5/10/2013	HSL	5800	0.1	75.4	78.9	-4.44%	Plot 149
5/13/2013	HSL	5200	0.1	72.8	80.3	-9.34%	Plot 150
5/13/2013	HSL	5800	0.1	81.7	78.9	3.55%	Plot 151
5/15/2013	HSL	5200	0.1	75	80.3	-6.6%	Plot 152
5/15/2013	HSL	5800	0.1	71.7	78.9	-9.13%	Plot 153
5/16/2013	HSL	5200	0.1	74.7	80.3	-6.97%	Plot 154
4/3/2013	MSL	835	1	10.4	9.57	8.67%	Plot 155
4/5/2013	MSL	835	1	10.3	9.57	7.63%	Plot 156
4/16/2013	MSL	835	1	10.1	9.57	5.54%	Plot 157
4/17/2013	MSL	835	1	10	9.57	4.49%	Plot 158
7/18/2013	MSL	835	1	9.71	9.57	1.46%	Plot 159
5/9/2013	MSL	1750	1	34	37.6	-9.57%	Plot 160
7/18/2013	MSL	1750	1	34.1	37.6	-9.3%	Plot 161
4/3/2013	MSL	1900	1	38	40.5	-6.17%	Plot 162
4/4/2013	MSL	1900	1	40	40.5	-1.23%	Plot 163
4/30/2013	MSL	1900	1	37.7	40.5	-6.91%	Plot 164
7/16/2013	MSL	1900	1	36.6	40.5	-9.63%	Plot 165
7/17/2013	MSL	1900	1	39	40.5	-3.7%	Plot 166
4/19/2013	MSL	2450	1	51.2	50.9	0.59%	Plot 167
5/7/2013	MSL	5200	0.1	66.6	73.7	-9.63%	Plot 168

5/8/2013	MSL	5200	0.1	73.6	73.7	-0.14%	Plot 169
5/9/2013	MSL	5200	0.1	68.7	73.7	-6.78%	Plot 170
5/9/2013	MSL	5800	0.1	67.1	74.3	-9.69%	Plot 171
5/13/2013	MSL	5200	0.1	70	73.7	-5.02%	Plot 172
5/13/2013	MSL	5800	0.1	67.8	74.3	-8.75%	Plot 173
5/14/2013	MSL	5800	0.1	66.9	74.3	-9.96%	Plot 174

NOTE:
1. Measured 1g SAR normalized to 1 W.

9. References

1. [IEEE 1999] IEEE Std C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., December 1998.

2. [IEEE 2003] IEEE Std 1528-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head From Wireless Communications Devices: Measurement Techniques. Inst. of Electrical and Electronics Engineers, Inc., December 2003.

3. [NIST 1994] NIST: Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results, Technical Note 1297 (TN1297), United States Department of Commerce Technology Administration, National Institute of Standards and Technology, September 1994.

4. [FCC 2001] Federal Communications Commission: Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), FCC, June 2001.

5. [FCC 20XX] Various FCC KDB Publications,
< http://transition.fcc.gov/oet/ea/eameasurements.html#sar>

6. [IC 2010] RSS-102: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), Industry Canada, Issue 4, March 2010.

7. [IC 2012] Notice 2012-DRS1203: RE: APPLICABILITY OF LATEST FCC RF EXPOSURE KDB PROCEDURES (PUBLICATION DATE: OCTOBER 24, 2012) AND OTHER PROCEDURES, Industry Canada, December 2012

10. Report History

Date	Report Name	Changes to report	Report prepared by
2013/08/28	SAR_INTEL-032-13001_FCC	First Version	Z Gray